

REMARKS:

Favorable reconsideration of the rejection of claims 8-13, 19, 23, 25, 27 and 30-32 as being anticipated by or obvious over the Lihme et al. patent is respectfully requested. The noted claims have been amended to clarify or emphasize at least one of the distinctions of the present invention over the disclosure of the Lihme et al. patent. In particular, the amendments clarify or emphasize that the support material is ceramic or perlite and bears an exterior coating of chitosan. This configuration with such support materials in combination has been found to yield surprisingly superior biosorption of heavy metals. For example, the subject specification notes explicitly at page 6, lines 27-30, that the biosorbent of the subject invention has been found to have a larger capacity for hexavalent chromium compared to that of pure chitosan or alumina by themselves.

The Office Action, however, does not identify any ceramic taught or suggested by the Lihme et al. patent. The Lihme et al. patent does refer to oxides of aluminum (col. 16, lines 15-20), to "siliceous glassy or ceramic materials" (col. 16, lines 36-53) and to "a certain type of surface treated perlite" (see col. 12, lines 25-37). However, the oxides of aluminum and "siliceous glassy or ceramic materials" are suggested as possible low density hollow particles or conglomerates. The Lihme et al. patent does not teach or suggest that one select just the right ceramic low density particles out of the dozens of low density particles identified and use it as a support material and then select chitosan out of the dozens of conglomerating agents and apply it to the support material as an exterior coating even though it is identified merely as a conglomerating agent, and that the chitosan would then not only be active, but yield the surprising results of super-activity the subject inventors have found to result from so combining a ceramic support material with chitosan as claimed. The "certain type of surface treated perlite" is mentioned in the Lihme et al. patent only as an active substance for adsorption of oil. Thus, its use by Lihme et al. would be an exterior component, rather than as a support material that in turn bears an exterior coating of chitosan, as required by the subject claims. Moreover, the only support material identified by the Lihme et al. patent as being used in combination with chitosan is not the perlite (or ceramics not even mentioned by Lihme et al.), but glass spheres. See col. 27, lines 12-26.

Lihme et al. nowhere teach or suggest combining chitosan with a ceramic or perlite as claimed in the subject claims or that the particular combination of chitosan with a ceramic or perlite as claimed in the subject application would yield any superior results, let alone the improved affinity of chitosan for biosorbing heavy metals as discovered by applicants. Indeed, the chitosan of Lihme et al. is used merely as a conglomerating agent, not as an active agent.

Lihme et al. does identify certain conglomerating agents may have some activity as well, but chitosan is not one of them. Thus, because Lihme et al. do not recognize any activity of chitosan in the first place, it is even more clear that Lihme et al. does not teach or suggest any advantage to such activity that could be achieved by coating the chitosan on a ceramic or perlite support member. Thus, claims 8-13, 19, 23, 25, 27 and 30-32 define patentably over the Lihme et al. patent.

In addition, claims 9-13, 19, 23, 25, 27 and 30-32 contain additional features that further distinguish the Lihme et al. patent. For example, claims 10 and 11 call for the support material to comprise (claim 10) or be (claim 11) ceramic alumina, ceramic silica or both. Claim 13 calls for the exterior chitosan coating to be exposed to a fluid environment, therefore further distinguishing the Lihme et al. compositions that further require an active agent coating over what might be chitosan. Claim 19 has been amended to be a process claim dependent from claim 17, which has not been rejected over the Lihme et al. patent. Thus, the rejection of claim 19 should be obviated. Claim 23 calls for the chitosan to be in dried gel form. This feature is not seen in the Lihme et al. patent. Claim 27 calls for the biosorbent composition to "consist essentially of" the ceramic or perlite support material bearing an exterior coating of chitosan, thus excluding other components that materially affect the novel and basic characteristics of the invention. Claim 30, as amended, calls for the support material to be ceramic alumina and for the support material to be derived from acid-treated chitosan gel. Claim 31 calls for the support material to bear a double coating of chitosan. Thus, these various claims distinguish patentably over the Lihme et al. patent for such additional reasons as well.

Favorable reconsideration also is requested of the rejection of claims 15-18, 21, 24, 26 and 28 as being obvious over the Muzzarelli patent in view of the Lihme et al. patent. Claims 15-18 and 24 are directed to a method that employs the composition as defined in claim 8 (by means of the identical wording as set forth in claim 8). The Muzzarelli patent does not disclose or suggest such composition, nor does it make up for the deficiencies in disclosing or suggesting such composition which were discussed above with respect to Lihme et al. patent. Therefore, the Muzzarelli patent, even in view of the Lihme et al. patent, does not render any of claims 15-18 or 24 obvious. Claim 21 is directed to a method that employs the composition as defined in claim 11. The Muzzarelli patent does not disclose or suggest such composition, nor does it make up for the deficiencies in disclosing or suggesting such composition which were discussed above with respect to Lihme et al. patent. Therefore, the Muzzarelli patent, even in view of the Lihme et al. patent, does not render claim 21 obvious. Claims 26 and 28 have been amended to call for a process employing the composition of claim 25 (in the case of claim 26)

and 27 (in the case of claim 28), each of which in turn depends from claim 8, and so claims 26 and 28 distinguish over the combination of the Muzzarelli and Lihme et al. patents for at least the reasons discussed above with respect to claims 15-18 and 24.

Favorable reconsideration also is requested of the rejection of claims 14 and 29 as being obvious over the Lihme et al. patent in view of the Glasser et al. patent. Claim 14 has been amended so that it now refers to the chitosan being in gel form rather than addressing the use of oxalic acid. Therefore, any arguable relevance of the Glasser et al. patent has been obviated by the amendment and claim 14, which depends from claim 8, distinguishes over the cited references for at least the reasons discussed above with respect to claim 8. Claim 29 depends from claim 8 and so is submitted to distinguish patentably over the Lihme et al. patent for the reasons discussed above with respect to claim 8. The Glasser et al. patent does not make up for these deficiencies. Claim 29 further calls for the support material to be ultrafine alumina. According to the Office Action, ultrafine alumina has a particle size of 10-150 microns and the Lihme et al. patent teaches alumina particles of that size at col. 15, lines 5-10. A review of this section shows that the particle ranges specified there refer to the conglomerate particles, not of the support material, let alone an alumina support material. Thus, claims 14 and 29 define patentably over the cited references, whether viewed individually or together.

In view of the foregoing, it is submitted that all claims now pending are in a condition for allowance and favorable consideration of all claims, withdrawal of pending rejections and early allowance of claims are earnestly solicited.

Respectfully submitted,



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